APPENDIX 10G

Geologic and Foundation Design Criteria

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10G.1 Introduction

This appendix includes the results of an initial geotechnical assessment for the project to support the Application for Certification (AFC). Appendix 8.15A, Initial Geotechnical Report, prepared by CH2M HILL (Santa Ana, California), is incorporated herein.

This Initial Geotechnical Report contains a description of the site conditions and preliminary foundation-related subsurface conditions. Soil-related hazards addressed include soil liquefaction, seismic and geological data, and construction considerations. Initial foundation and earthwork considerations are addressed based on the results of two new boreholes and established geotechnical engineering practices.

Information contained in this appendix reflects the codes, standards, criteria, and practices that will be used in the design and construction of site and foundation engineering systems for the facility. More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specification and construction specifications.

10G.2 Scope of Work

The scope of geotechnical services for the preparation of this appendix included an assessment of soils-related hazards, a summary of preliminary foundation and earthwork considerations, and preliminary guidelines for inspection and monitoring of geotechnical aspects of construction based on available published data as analyzed in Subsection 8.15 of this AFC.

10G.3 Site Conditions

The project site is located on a 13.7-acre parcel zoned for general industrial use. The site is currently occupied by an existing operating facility. The proposed site is relatively flat (approximate elevation 180 feet). A conceptual drainage plan for the site is shown in Figure 8.14-3. The site will drain to a detention basin before final discharge into the Los Angeles County Flood Control District's stormwater drainage system. Although the historic high groundwater level in the vicinity is at approximately 30 feet below existing grade, geotechnical and environmental investigation studies have documented that groundwater is not present at shallow levels and will not be a concern for the construction of these foundations.

10G.4 Site Subsurface Conditions

10G.4.1 Stratigraphy

The stratigraphy is shown in Appendix A of the Initial Geotechnical Report (Geotechnical Boring Logs, H-1 and H-2). Additional borings will be performed at the project site to verify the soil consistency and characteristics during the Final Report phase.

10G.4.2 Seismicity / Ground-Shaking

The project site is subject to the probability of seismic activities. The nearest fault system is located approximately 3.1 miles from the project site. Maximum credible earthquake is 7.1. Per the California Building Code (CBC), the site is located in Seismic Zone 4. The CBC Near Source Factors: Na=1.0; Nv=1.2 (CBC-2001).Seismic Source Type: Type B (CBC-2001).

The project site is susceptible to ground-shaking during major earthquakes from the Puente Hills Blind Thrust Fault. The seismic risk to structures depends upon the distance to the epicenter; the characteristics of the earthquake, the geologic, groundwater, and soil conditions underlying the structures and their vicinity. Due to the site distance from the above faults and the subsurface conditions, maximum horizontal ground acceleration is expected to be on the order of about 0.47 g. Maximum credible earthquake PBA: 0.64 g.

10G.4.3 Ground Rupture

Ruptures along the surface trace of a fault tend to occur along lines of previous faulting. There is no evidence of potentially active fault trace at the nearby site; and thus the primary hazard of surface rupture at the project site is expected to be negligible. However, a ground rupture study at the project site will be performed as part of the geotechnical investigation in order to verify this assumption.

10G.4.4 Liquefaction Potential

Soil liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing cyclic shear stresses associated with earthquakes. Based on the anticipated relative density of the cohesionless sediments near the project site, it is expected that the potential for liquefaction is low. Liquefaction-induced settlements are estimated to be 1.0 and 0.5 inches.

10G.4.5 Groundwater

The historical high groundwater level in the vicinity is 30 feet below the ground surface. No free groundwater was encountered during drilling of the two borings (81 feet deep) made for the Initial Geotechnical Report. The relatively low moisture content of the soil samples indicate that the ground water level was below the boring depth at the time of drilling. The groundwater elevation will be confirmed during the geotechnical investigation for final design.

10G.5 Assessment of Soil-Related Hazards

10G.5.1 Liquefaction

Soil liquefaction is a process by which loose, saturated, granular deposits lose a significant portion of their shear strength due to pore water pressure buildup resulting from cyclic loading, such as that caused by an earthquake. Soil liquefaction can lead to foundation bearing failures and excessive settlements when:

- The design ground acceleration is high (up to 0.4 g)
- The water level is relatively shallow
- Low standard penetration tests (SPT) blow counts are measured in granular deposits (suggesting low soil density)

The results of the subsurface investigation at the nearby site indicate low to moderate potential for liquefaction.

10G.5.2 Expansive Soils

Soil expansion is a phenomenon by which clayey soils expand in volume as a result of an increase in moisture content, and shrink in volume upon drying. Expansive soils are usually identified with index tests, such as percentage of clay particles and liquid limit. It is generally accepted that soils with liquid limits larger than about 50 percent (i.e., soils that classify as high plasticity clays [CH] or high plasticity silts [MH]) may be susceptible to volume change when subjected to moisture variations.

The soils encountered in the borings, based on laboratory expansion index testing, the expansion potential of the soil encountered is low. No special design and specific recommendations are required to mitigate the expansive characteristics of the onsite soils.

10G.5.3 Collapsible Soils

Soil collapse (hydrocompaction) is a phenomenon that results in relatively rapid settlement of soil deposits due to addition of water. This generally occurs in soils having a loose particle structure cemented together with soluble minerals or with small quantities of clay. Water infiltration into such soils can break down the interparticle cementation, resulting in collapse of the soil structure. Collapsible soils are usually identified with index tests, such as dry density and liquid limit, and consolidation tests where soil collapse potential is measured after inundation under load.

Based on the available data, the potential for soil collapse at the site is expected to be low.

10G.6 Preliminary Foundation Considerations

10G.6.1 General Foundation Design Criteria

For satisfactory performance, the foundation of any structure must satisfy two independent design criteria. First, it must have an acceptable factor of safety against bearing failure in the foundation soils under maximum design load. Second, settlements during the life of the structure must not be of a magnitude that will cause structural damage, endanger piping connections or impair the operational efficiency of the facility. Selection of the foundation type to satisfy these criteria depends on the nature and magnitude of dead and live loads, the base area of the structure and the settlement tolerances. Where more than one foundation type satisfies these criteria, then cost, scheduling, material availability and local practice will probably influence or determine the final selection of the type of foundation.

An evaluation of the information collected for the AFC indicates that no adverse foundation-related subsurface and groundwater conditions would be encountered that would preclude the construction and operation of the proposed structures. The site can be considered suitable for development of the proposed structures, pursuant to completion of a geotechnical investigation, and the preliminary foundation and earthwork considerations discussed in this appendix.

10G.6.2 Shallow Foundations

Completion of the geotechnical investigation will determine if the proposed structures can be supported directly on the native soils. Shallow foundation construction will require the earthwork measures discussed in Subsection 10G.7.

Allowable bearing pressures will include a safety factor of at least 3 against bearing failures. Settlements of footings are expected to be limited to 1 inch, and differential settlement between neighboring foundations to less than 0.5 inch. Tanks can usually undergo much larger settlements.

Pursuant to a geotechnical investigation, exterior foundations should be placed at a depth of at least 2 feet below the ground surface for protection. Interior footings can be placed at nominal depths. The minimum recommended width is 3 feet for spread footings and 2 feet for wall footings.

10G.6.3 Deep Foundations

Compressible soils are not expected based on information analyzed for the project. Deep foundations will be required for heavily loaded foundations, and for foundations subjected to high lateral loads. A detailed final geotechnical report will provide recommendations for the design of deep foundations.

10G.6.4 Corrosion Potential and Ground Aggressiveness

Corrosivity tests were conducted to determine whether the site soils are non corrosive or corrosive for buried steel based on the chloride content and pH values. Type II cement shall be used for grounding purposes, the minimum resistivity will be 4,770 ohm-cm at 31 percent moisture content.

10G.7 Preliminary Earthwork Considerations

10G.7.1 Site Preparation and Grading

Prior to transfer of the property to the City of Vernon, all buildings and structures will be removed, and the site will be remediated and rough graded. Therefore, no trees, structures, or debris will be removed from the project site as part of the project. The proposed (Figure 8.14.4) site grading indicates the work required to bring the site to finished grade.

The Initial Geotechnical Report outlines recommendations for over excavation and backfill for spread footings and mats.

10G.7.2 Temporary Excavations

It is anticipated that confined temporary excavations at the site will be required during construction for the installation of the circulation water pipes and the cooling tower forebay. All excavations shall be sloped in accordance with Occupational Safety and Health Act (OSHA) requirements. Sheet piling could also be used to support any excavation. The need for internal supports in the excavation will be determined based on the final depth of the excavation.

10G.7.3 Permanent Slopes

Cut and fill slopes shall be 2h:1v (horizontal to vertical) maximum. Embankments for creek diversions, if required, shall be 5h:1v maximum.

10G.7.4 Backfill Requirements

All fill material will be free of organic matter, debris, or clay balls, with a maximum size not exceeding 3 inches. Structural fill will also have a Plastic Index of less than 15, a Liquid Limit of less than 35, and a maximum fine content (passing the 200 sieve) of 40 percent. Expansion index shall be less then 20. These fill material requirements may be adjusted on a case-by-case basis during the design process. Granular, uniformly graded material with a maximum aggregate size of 0.5 inch may be used for pipe bedding. Based on the available site grading, it is anticipated that fill material will be available onsite.

Structural fill will be compacted to at least 95 percent of the maximum dry density as determined by American Society for Testing and Materials (ASTM) D 1557 when used for raising the grade throughout the site, below footings or mats, or for rough grading. Fill placed behind retaining structures may be compacted to 90 percent of the maximum dry density as determined by ASTM D 1557. Initially, structural fill will be placed in lifts not exceeding 6-inches loose thickness. Thicker lifts may be used pursuant to approval based on results of field compaction performance. The moisture content of all compacted fill will fall within 3 percentage points of the optimum moisture content measured by ASTM D 1557, except the top 12 inches of subgrade will be compacted to 95 percent of ASTM D 1557 maximum density.

Pipe bedding can be compacted in 12-inch lifts to 90 percent of the maximum dry density as determined by ASTM D 1557. Common fill to be placed in remote and/or unsurfaced areas

may be compacted in 12-inch lifts to 85 percent of the maximum dry density as determined by ASTM D 1557.

10G.8 Inspection and Monitoring

A California-registered Geotechnical Engineer or Engineering Geologist will monitor geotechnical aspects of foundation construction and/or installation and fill placement. At a minimum the Geotechnical Engineer/Engineering Geologist will monitor the following activities:

- Surfaces to receive fill will be inspected prior to fill placement to verify that no pockets of loose/soft or otherwise unsuitable material were left in place and that the subgrade is suitable for structural fill placement.
- Fill placement operations will be monitored by an independent testing agency. Field compaction control testing will be performed regularly and in accordance with the applicable specification to be issued by the Geotechnical Engineer.
- Settlement monitoring of significant foundations and equipment is recommended on at least a quarterly basis during construction and the first year of operation, and then semi-annually for the next 2 years.

10G.9 Site Design Criteria

10G.9.1 General

The project will be located in the City of Vernon, California. The approximate 13.7-acre site is relatively flat, with existing permanent structures. However, prior to the transfer of title to the City of Vernon, all buildings and structures will be removed, and the site will be remediated and rough graded. The site would be accessible from both Boyle and Fruitland Avenue. However, preferred primary access will be from Fruitland Avenue and secondary access will be from Boyle Avenue.

10G.9.2 Datum

The site grade varies between elevation 176 to 180 feet, mean sea level, based on the U.S. Geological Survey (USGS) Quad Map information and the 1929 National Geodetic Vertical Datum (NGVD). Final site grade elevation will be determined during detailed design.

10G.92 Foundation Design Criteria

10G.9.1 General

Reinforced concrete structures (spread footings and mat foundations) will be designed consistent with Appendix 10B. The Initial Geotechnical Report outlines net allowable bearing pressures based on the lab results from preliminary borings.

Allowable soil bearing pressures for foundation design will be in accordance with this Appendix and the detailed final geotechnical investigation for the site.

10G.9.2 Groundwater Pressures

Hydrostatic pressures due to groundwater or temporary water loads should not have to be considered.

10G.9.3 Factors of Safety

The factor of safety for structures, tanks and equipment supports with respect to overturning, sliding, and uplift due to wind and buoyancy will be as defined in Appendix 10B, Structural Engineering Design Criteria.

10G.9.4 Load Factors and Load Combinations

For reinforced concrete structures and equipment supports, using the strength method, the load factors and load combinations will be in accordance with Appendix 10B, Structural Engineering Design Criteria.

10G.10 References

California Building Code. 2001.

Department of the Navy.1982. "Identification and Classification of Soil and Rock." Chapter 1 in *Soil Mechanics Design Manual 7.1*. Naval Facilities Engineering Command. Alexandria, VA.

Caltrans. 1996. "California Seismic Hazards Map."